

Section 1

Neonatal intensive care

“Luck is where preparation meets opportunity.”

This section consists of 16 medication orders followed by corresponding patient profiles representing pharmacotherapy associated with patients admitted to a neonatal intensive care unit. Each patient profile is followed by multiple-choice questions pertaining to the medication order and profile information. Choose the one best-lettered response to each item. The correct answers are provided at the end of this section. The reader is encouraged to attempt all questions for each case or for the entire section prior to referring to the answers. Moreover, where appropriate, the answer key provides a thorough explanation of the correct response and should serve as an additional learning tool for the reader.

Medication orders

Physician order

Patient weight: 2.5 kg

Aminophylline 10 mg iv load, then begin 2.5 mg iv q 12 h

Obtain theophylline concentration 1 h postinfusion of loading dose

Date/time: 12/01/2100

Patient name: Baby Boy Turner

Physician: *John Craver*

Patient ID: 111222

Medical profile

Patient: Baby Boy Turner

Patient weight: 2.5 kg **Age:** 1 d/o

Present illness: Apneic episodes **Allergies:** None

Medical history: 33 weeks gestation, Apgar 7 and 9

Labs: pending

Medication profile

Questions

Q1 Which of the following is an acceptable definition of apnea of prematurity?

- 1** cessation of breathing for less than 20 s
 - 2** cessation of breathing for at least 20 s
 - 3** cessation of breathing for less than 20 s when accompanied by bradycardia
- A 1 only
B 3 only
C 1 and 3 only

- D 2 and 3 only
- E 1, 2, and 3

Q2 Which of the following drug classes is represented by aminophylline?

- A glucocorticoid
- B methylxanthine
- C beta-adrenergic agonist
- D antihistamine

Q3 Which is true regarding Baby Boy Turner's aminophylline regimen?

- 1 the loading and maintenance doses should be increased
 - 2 the loading dose should be decreased
 - 3 the maintenance dose should be decreased
- A 1 only
 - B 3 only
 - C 1 and 3 only
 - D 2 and 3 only
 - E 1, 2, and 3

Q4 Which of the following would be the most appropriate method of administration of Baby Boy Turner's aminophylline?

- A an intravenous push over 5 min
- B an intravenous infusion over 12 h
- C an intravenous infusion over 30 min
- D loading dose infused over 5 min followed by the maintenance dose infused over 12 h

Q5 Which of the following is a potential adverse effect from aminophylline therapy?

- 1 tachycardia
 - 2 worsening gastroesophageal reflux
 - 3 agitation
- A 1 only
 - B 3 only
 - C 1 and 3 only
 - D 2 and 3 only
 - E 1, 2, and 3

Q6 Which of the following is true regarding aminophylline use in Baby Boy Turner?

- A aminophylline salt is ~80% theophylline
- B half-life is ~40–230 h
- C therapeutic concentrations often result in urinary retention
- D may only be diluted with normal saline

Q7 As ordered, Baby Boy Turner's theophylline concentration should be approximately _____ mcg/mL (volume of distribution = 0.7 L/kg).

- A 4.6
- B 5.7
- C 11.4
- D 14.2

Q8 Which of the following is an alternative drug that may have been prescribed to Baby Boy Turner?

- 1 caffeine
 - 2 doxapram
 - 3 oral aminophylline
- A 1 only
 - B 3 only
 - C 1 and 3 only
 - D 2 and 3 only
 - E 1, 2, and 3

Q9 How many milliliters of a 500 mg/20 mL aminophylline solution are required to prepare 10 mL of a 2 mg/mL dilution?

- A 0.08
- B 0.8
- C 8
- D 80

Q10 The recommended therapeutic serum concentration of theophylline for patients such as Baby Boy Turner is _____ mcg/mL.

- A 5–10
- B 5–15
- C 10–20
- D 15–25

- Q11** Caffeine citrate 40 mg is equivalent to _____ mg of caffeine base.
- A 10
 - B 20
 - C 40
 - D 80
- Q12** Which of the following is a metabolite of theophylline?
- 1 L-methylxanthine
 - 2 caffeine
 - 3 L-methyluric acid
- A 1 only
 - B 3 only
 - C 1 and 3 only
 - D 2 and 3 only
 - E 1, 2, and 3
- Q13** Which of the following is typically not recommended for neonates due to interacting competitively with bilirubin at albumin binding sites?
- A caffeine base
 - B caffeine sodium benzoate
 - C caffeine citrate
 - D anhydrous caffeine
- Q14** Which of the following would be the most appropriate loading dose (mg/kg) of caffeine citrate for the treatment of apnea of prematurity?
- A 5
 - B 7.5
 - C 20
 - D 30

Answers

A1 D

Apnea of prematurity is defined as cessation of breathing for at least 20 s or less than 20 s when accompanied by bradycardia, cyanosis, or pallor.

A2 B

Aminophylline, theophylline, and caffeine are methylxanthines.

A3 A

There is an increased volume of distribution ($\sim 0.7\text{--}1\text{ L/kg}$) for theophylline in preterm neonates compared to children and adults. Therefore, a higher loading dose (aminophylline $8\text{--}10\text{ mg/kg}$) would be more appropriate, especially if an initial higher theophylline serum concentration is desired. A reasonable initial maintenance dose would be 2.5 mg/kg every 12 h. Therefore, a reasonable initial aminophylline regimen for Baby Boy Turner would be a loading dose of $20\text{--}25\text{ mg}$ ($8\text{--}10\text{ mg/kg}$) and a maintenance dose of 6 mg iv every 12 h ($2.5\text{ mg/kg} \times 2.5\text{ kg} = 6.25\text{ mg}$).

A4 C

Intravenous aminophylline is most often administered as a 30-min infusion.

A5 E

Potential adverse effects of aminophylline include stimulation of the CNS and cardiovascular system. It also decreases lower esophageal sphincter pressure that may aggravate gastroesophageal reflux.

A6 A

Aminophylline salt is $\sim 80\%$ theophylline. The half-life in neonates is $\sim 30\text{--}40\text{ h}$. Diuresis is a potential effect of all methylxanthines, including aminophylline. Aminophylline may be diluted in normal saline or 5% dextrose.

A7 A

To estimate the concentration post loading dose, the equation $\text{concentration} = \text{dose}/\text{volume of distribution}$ may be used. Since aminophylline is 80% theophylline, a 10 mg dose of aminophylline equals 8 mg theophylline ($10\text{ mg} \times 0.8$ (80% theophylline) = 8 mg theophylline). In order for the units to cancel, the dose may be expressed in mg/kg . Therefore, $8\text{ mg}/2.5\text{ kg} = 3.2\text{ mg/kg}$. So, $\text{concentration} = 3.2\text{ mg/kg}/0.7\text{ L/kg} = 4.6\text{ mg/L}$ or mcg/mL .

A8 E

Caffeine is another methylxanthine that is often prescribed, and the preferred therapy by many clinicians, for apnea of prematurity. Although not as well studied, doxapram is a nonmethylxanthine alternative; however it does contain a large amount of benzyl alcohol. Adverse effects include hypertension, abdominal distension, and CNS stimulation. Initial loading and maintenance doses are 3 mg/kg and 1 mg/kg/h, respectively. Oral aminophylline may have also been prescribed.

A9 B

To prepare 10 mL of a 2 mg/mL dilution, 20 mg are needed ($10 \text{ mL} \times 2 \text{ mg/mL} = 20 \text{ mg}$). Therefore, $500 \text{ mg}/20 \text{ mL} = 20 \text{ mg}/x$; $x = 0.8 \text{ mL}$.

A10 B

Although some patients may require higher theophylline serum concentrations (i.e., 10–20 mcg/mL) for therapeutic benefit, most will appreciate desired outcomes, while avoiding adverse effects, at lower concentrations.

A11 B

Caffeine citrate is 50% caffeine base. Caffeine citrate $40 \text{ mg} \times 0.5$ (50%) = 20 mg caffeine base.

A12 E

L-methylxanthine and L-methyluric acid are metabolites of theophylline in both children and adults. Caffeine is a theophylline metabolite during the neonatal period.

A13 B

Caffeine sodium benzoate may result in increased free bilirubin concentrations due to competitively interacting at the albumin-binding sites, thus possibly leading to kernicterus.

A14 C

Caffeine citrate 20 mg/kg = caffeine base 10 mg/kg; an appropriate loading dose for an initial concentration of $\sim 10\text{--}15 \text{ mg/L}$.

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